F1-002

United States Department of the Interior

BUREAU OF RECLAMATION
Reclamation Service Center
P.O. Box 25007
Building 67, Denver Federal Center
Denver, Colorado 80225-0007

IN REPLY REFER TO

D-8570
Res. 3.10

JUL 18 1997

Kate Hansel
CALFED Bay-Delta Program Office
1416 Ninth Street, Suite 1155
Sacramento, CA 95814

Subject: Submittal of Proposal for 1997 Category III, Ecosystem Restoration Projects

Dear Ms. Hansel:

In response to the CALFED Bay-Delta program request for proposals under 1997 Category III, enclosed are ten copies of the proposal for "Modification and Application of Existing Tools to Process Data for Models Used in the CALFED Program. This proposal is a combined effort of the Department of Interior Bureau of Reclamation, the Environmental Protection Agency Office of Water, and the Colorado State University Integrated Decision Support Group.

Please forward the copies of the proposal to appropriate committees for selection. I look forward to working with you again in the future.

If you have any questions, please call either Dr. Luis Garcia at (970) 491-2293, Dr. Russell Kinerson at (202) 260-1330, or myself at (303) 236-8384 x 278. Thank You.

Sincerely,

Merlynn D. Bender

Merlynn D. Bender, P.E.
Technical Service Center
Environmental Engineer
Land Suitability and Water Quality Group

Enclosures

cc: Dr. Luis Garcia, IDS, 410 USC, Fort Collins, CO 80523
Dr. Russel Kinerson, EPA, 401 M. Street S.W., Mailcode 8623, Washington, D.C. 20460
(w/1 copy of encl to each)

F1·002

Proposal for Modification and Application of Existing Tools to Process Data for Models Used in the CALFED Program

By: Merlynn Bender, M.S.Env.Eng., P.E. *, Luis Garcia, Ph.D.**,

and Russell Kinerson, Ph.D. ***

* U.S. Dept. of Interior, Bureau of Reclamation, Land Suitability and Water Quality Group

** Colorado State University, Director of Integrated Decision Support Group

*** U.S. Environmental Protection Agency, Chief of Science and Technology

I. Executive Summary and III. Project Description

Problem Description:

Large amounts of existing water quality, ecological, and biological data need to be assembled, processed, and placed in a useable format for modelers and decision makers.

Project Description and Approach

A tool has recently been developed for use in assembling, processing, and assessing large amounts of a variety of water quality, ecological, and biological data for modeling projects. The tool allows the user to select data from various locations and time periods and combine data sets from various data bases and files using unit conversion. With slight modifications, this tool could be used for evaluations or various models used in the CALFED program.

In cooperation with Colorado State University (CSU), a State Controlled Institution of Higher Learning, under Program Statutory Authority Public Law 104-046, the United States Bureau of Reclamation (Reclamation) Technical Services Center and the United States Environmental Protection Agency (EPA) Office of Water have funded and assembled the framework for a graphical user interface (GUI) to process, assemble, and assess data for water quality models. The tool was originally designed to process and format data for EPA's Water Analysis Simulation Program (WASP). The tool currently processes data from EPA's STORET data base, U.S. Geological Survey's WATSTORE data base, and files with a common delimiter between data points (such as a tab, comma, or colon). This tool could be used "as is" or adapted to assemble and process a variety of data types for Bay-Delta issues and models, particularly riverine issues. To provide an example, this proposal focuses on application of a WASP model to a riverine environment. However, the tool and approach can be adapted for a variety of models and environments to address client needs to study various priority habitats and species.

Reclamation engineers, scientists, and technicians and CSU students have worked as a team to produce this tool. A wealth of experience from talented CSU, Reclamation, and EPA professionals are available to address client needs.

Project Objectives:

Modify and apply existing data processing tools for use in assembling and processing of riverine and estuary Bay-Delta water quality, ecological, and biological modeling data sets.

Develop a user-friendly tool to assess toxic and metal transformation and transport in rivers or other environments.

Expected Benefits:

- The tool is currently available for efficiently processing large amounts of water quality, ecological, and biological data. Processing of the data could be done by technicians on a cost plus fixed fee (CPFF) contract.
- Pre- and post- processing tools for EPA's Water Analysis Simulation Program Version 5.0 (WASP5) including input data aggregation and sensitivity analysis tools.
- Node-segment interface for entering WASP input data and data card processor for creating WASP5 input files
- Links to additional EPA models such as MINTEQ and BASINS and inclusion of the metals version of WASP (i.e. META).
- Documentation and technology transfer.

Purpose:

The Colorado State University Integrated Decision Support (IDS) Group with cofunding from the U.S. Department of Interior Bureau of Reclamation (Reclamation) Land Suitability and Water Quality Group and the U.S. Environmental Protection Agency Office of Water is assembling user-friendly analysis tools for EPA's WASP5 model. The object-oriented Graphical User Interface (GUI) system developed with Microsoft Visual C++ allows users to more easily process data sets and apply them to toxic riverine environments for the determination of toxic transport, particularly heavy metals. Additional funding is needed to continue development, integrate existing water analysis tools into the framework, and expand the usability of the WASP model.

Temperature, salinity, oxygen, and simple nutrient budgets can be modeled with existing water quality models. However these models do not properly represent toxics that change rapidly with time and distance or that react, transform, or are adsorbed onto suspended materials. These processes need to be incorporated into existing models which can simulate parameters such as toxic metals. WASP is a computer programming system for modeling toxics, nutrients, and metals. WASP can be used to evaluate which intraphase or interphase exchange processes such as settling, suspension, adsorption, desorption, volatilization, or hydrolysis can be used to simulate the partitioning of chemicals and metals in the air, water, and soil. However, correctly assembling data for the WASP model is difficult. Therefore, a set of pre- and post-processors

which provide data integration and data manipulation are being developed to make the WASP model easier to apply to problems and then to display modeling results.

Current Project:

The current pre-processor (Graphical WASP or GWASP) allows the user to extract, analyze, and combine data from EPA's database STORET, the U.S. Geological Survey's (USGS) database WATSTORE, and comma delimited files. The analysis consists of graphically determining the periods where data are available (using daily, weekly, or monthly time steps). The user can include data from STORET, WATSTORE, and project specific tab delimited data files into the WASP dataset using the GWASP module. GWASP can be used to determine the data availability (Figure 1) and aggregate parameters and stations to create a dataset for WASP. The system can also be used to determine periods of time where data are available for a given parameter from different stations, or when a station has data regardless of parameter type. The user can select a period of time, a time step, and a parameter to generate an output file that will be incorporated into WASP.

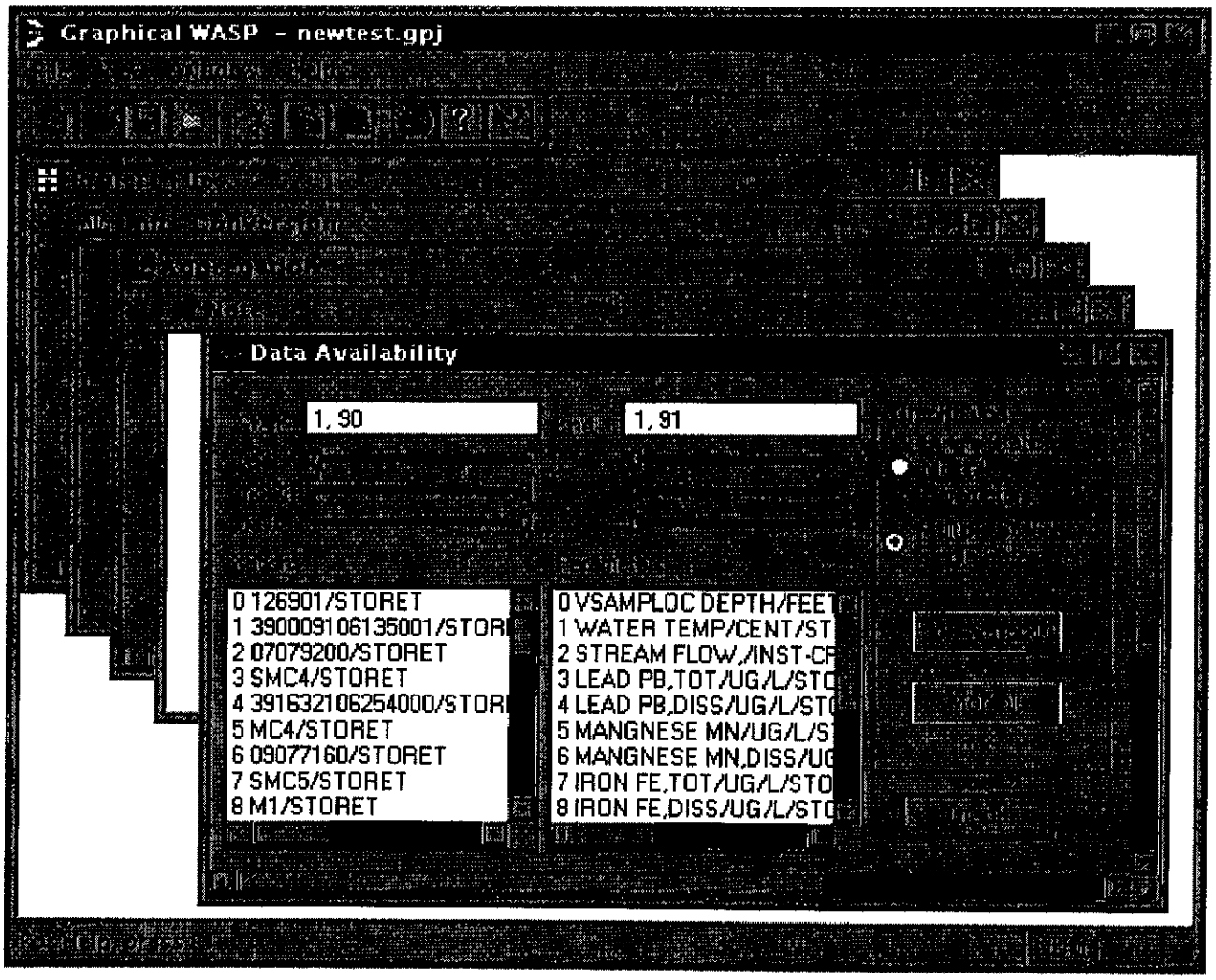

Figure 1. Data Availability Screen for the GWASP Module

The GWASP program will be part of the WASP Analysis Tools (WASPAT) system. WASPAT will contain additional tools for data pre and post processing. The current development efforts for WASPAT has focused on toxic metals component of WASP (META).

The WASP dataset is divided into blocks of data referred to as cards, depending on the option of WASP that the user is running (EUTRO, TOXI, or META). Each dataset for a model is composed of a collection of data cards (blocks of data). Each card can be separated into an individual file for temporary storage. These files can then be combined in different ways to create a single WASP input file. To facilitate this ability, descriptions of the data cards can be saved in each file and a general project file can be used to keep track of global conditions for each project such as the number of segments and the time step.

The user can select different combinations of data cards for a given project and keep track of how the changes effect model runs. For example, once the network of segments and boundaries is set up as a project the user can create or import files with different flows (stored in the C card) while leaving the rest of the cards the same. The system also does some error checking to insure that the cards selected are compatible.

Existing WASP input files created for the META option can be read into the system and used to populate the interface. The META4 fortran code has be updated to work with WASP5. From the interface, a WASP5 input file can be generated.

A User Manual in hardcopy and on-line (Microsoft Help files) versions has been developed for the existing tools and will be expanded as the project progresses. In addition to the user-focused documentation, a programmers reference has been generated to document the routines developed for the interface. A technical paper is also being prepared for the Federal Interagency Hydrological Modeling Conference in April of 1998.

The current version of the system runs on a personal computer (PC) under Windows 95. The current implementation of the system uses a link-node approach to display the layout of the network on the screen. Each node on the screen describes a segment or a boundary between segments. When segments or boundaries are selected with the mouse the user can import data files or populate them using an interface.

Proposed Tasks for Additional Funding:

To date, efforts have concentrated on developing aids and graphical displays for "input" data. Some work is still required to provide some additional capabilities to the user for the analysis and operation of the input process. There is also a need to develop aids and graphical displays to "output" model data, sensitivity analysis, and the ability to compare input data with measured field data. Depending on funding availability potential areas of development could include the following areas:

Modeling Enhancements:

1. Linking to BASINS (Better Assessment Science Integrating Point and Nonpoint Sources)

- BASINS is EPA's comprehensive software package designed to enable water quality analysts and watershed managers to perform studies using ArcView, watershed data, and state-of-the-art environmental assessment modeling tools. The tool is designed to develop pollutant limits

for point sources, best management practices (BMPs) for nonpoint sources, and total maximum daily loads (TMDLs) for a watershed.

- Linking to EPA's watershed management software, BASINS, could provide data input for the WASP model and provide BASINS users with modeling capabilities that the current steady-state toxics model, TOXIROUTE does not have.

2. Incorporation of Geographic Information System (GIS) capabilities

- The incorporation of Geographic Information System (GIS) capabilities is being explored to allow the user the ability to visualize the location of the sampling stations, streams and other features (cities, treatment plants, roads, etc.) and the linear representation (link-node) of the system.
- The current GUI is being implemented as a link-node system. If additional geographical information or the WASPAT system is linked with BASINS (which uses ArcView) then it would be advantageous to integrate GIS into the displays.
- An application of GIS could be the ability to display the transformation and transport of chemicals down a river. For example, a user could display chemical concentration of metals per segment or by boundary with a color code linked to concentration thresholds. In either case the user could see the spatial and the temporal changes in concentration by displaying data sets for different times steps.

3. Determining Dominant Chemical Reactions Using MINTEQA2

- One of the key issues when using the METALS option of WASP is the determination of the dominant chemical reactions and the data associated with them. Presently the Environmental Protection Agency (EPA) has a model called MINTEQA2 that is typically used in the determination of dominant chemical reactions and associated coefficients.
- The chemical coefficients of METALS component of WASP is very similar in format to the data contained in the MINTEQA2 database and therefore a link between the two models in an interface would be useful. This could be done by allowing the user to run the MINTEQA2 model as an external process from the WASPAT interface and exchanging files.
- The WASPAT system could allow the user to select important chemical reactions from a menu. MINTEQA2 could be run and the chemical coefficients from MINTEQA2 could be used by WASPAT for a WASP input file. An override feature would be built to allow experienced aquatic- and geo-chemists to enter chemical coefficients directly into an interface or ASCII data files with coefficient selections.

4. Expand Current Capabilities to Work with the EUTRO and TOXI Options

- Expand the functionality of WASPAT to support the EUTRO and TOXI options. The present development is focusing on the metals component of WASP. However, much of the data required by META overlaps with the data required by EUTRO and TOXI. It would be desirable to provide the additional capability to edit datasets for both EUTRO and TOXI using WASPAT.

5. Statistical Tools for "Filling" Data

- When working with existing data from STORET, WATSTORE, and project specific data, an important issue has been the generation of data to fill data gaps. For this purpose it would be

valuable to have the capability to fill in data using statistical approaches, such as linear and non-liner interpolation, multivariate regression, and synthesis of data from surrounding stations. This would allow a user to take existing data with its data gaps and generate complete data sets that could be modeled using WASP.

- A complimentary feature would be sensitivity analysis tools with the capability for comparing data filling techniques. This tool would give the user the flexibility to decide which data filling technique works best for a particular data set or area.

6. Incorporation of Data from EPA River Reach Files for Building Networks

- The EPA River Reach Files include data for segment or reach numbers, sequence numbering, segment length, reach names, segment velocities at low, mean, and high flows, reach elevation differences, mean temperature, mean pH, roughness coefficient and other data that could be used to populate a WASP Input file. The user could have the ability to import an EPA River Reach file for the location being modeled.

7. Using DYNHYD to Generate Flows for WASP

- The DYNHYD model could be run interactively from the WASPAT interface to generate flows for a WASP run. Tools developed for sensitivity analysis for WASP could also be used for DYNHYD as an additional step for determining flow parameters.

8. Screening Tools for Identifying and Ranking Priorities

- Tools might include linkages to remote sensing techniques, such as AVIRIS; linkages to the U.S. Geological Survey National Geochemical Data Base, such as the National Uranium Resource Evaluation (NURE) data for the Conterminous Western United States to identify problem drainage areas; and comparisons to indexes, hazard protocols, or baselines such as the Lemly Index for selenium, Crustal Abundance Value (CAV) baselines for metals, state and federal water quality standards, and detection limits.

9. Decision Support for Applying Results

- Development of a decision support system to integrate biological, recreational, economic, technical, legal, and political concerns.

10. Error Checking for Improper Input Coefficients and Adequate Ranges Of Inputs

- Error checking for improper input coefficients and adequate range of inputs. This would be a valuable feature to add to the system, especially if some guidelines could be implemented to provide not only the range of values that a parameter can physically have (screen for typos and bad data) but also provide some guidelines for values commonly used under different types of conditions.

Testing and Implementation:

1. Testing the System on both High and Low Flow Locations

- Test the system on a fast moving stream (high flow) application which is dominated by colloidal loads of toxic metal compounds (possibly Spring Creek on Iron Mountain Watershed).

Test the system on a slow moving stream (low flow) application which is dominated by dissolved species of toxic metals.

2. Test High and Low Conditions at the Same Location

- Possible application sites might include:
  - Iron Mountain watershed draining into the Sacramento River.
  - River reaches downstream of Superfund sites
  - Determination of TMDLs downstream of polluted areas

Graphical User Interface:

1. Evaluation of Current PREWASP preprocessor

- To assure complementary development, the existing PREWASP program should be evaluated to determine the strengths and weaknesses of the approach and determine development of new functionality that is complementary to the existing effort.
- Possible inclusion of the current PREWASP preprocessor into the WASPAT.

2. Develop an Interface for Generating Input File Series for Sensitivity Analysis

- Develop an interface window to generate a sequence of sensitivity runs automatically for investigation of major forcing functions and dominant coefficients.
- This interface would provide the user with the ability to generate multiple input files for WASP runs and to analyze the differences in the output for user specified parameters. This could be done by allowing the user to select the parameters and segments they wanted to track for a set of model runs generated with the sensitivity tool and graph them. For example pH or metal concentrations could be graphed with the segments and model runs where the flow at a gaging station is changed.

Documentation and Technology Transfer:

1. User Manual

- The current on-line and hardcopy user manual will continue to be updated with information on how to use the new functionality of the systems.

2. Technical Documentation

- Documentation of the most advanced research version of the WASP metals subprogram, META Version 2.0, which includes the two layer adsorption modeling approach similar to those found in MINTEQA2, EPA's geochemical equilibrium speciation model. MINTEQA2 is capable of computing equilibria among the dissolved, adsorbed, solid, and gas phases in an environmental setting.
- Technical appendixes could be generated with common combinations of chemical reactions in streams with toxic levels of metals.
- Documentation of programming routines used to build the Interface.

3. Technology Transfer

- Refereed journals and conferences will be explored for transferring the technology to public and government scientists, engineers, and managers.

Demonstration:

Interested parties are invited to request a demonstration version of the software.

Please Contact:

Dr. Luis Garcia
Colorado State University
Integrated Decision Support Group
601 South Howes Street, #410
Fort Collins, Colorado 80523 USA

E-mail: garcia@engr.Colostate.EDU

Telephone: (970) 491-5144

FAX: (970) 491-2293

For project management:

Please Contact:

Merlynn D. Bender
Technical Service Center
Land Suitability and Water Quality Group
Denver Federal Center, D-8570
P.O. Box 25007 (D-8570)
Denver, Colorado 80225 USA

E-mail: mbender@do.usbr.gov

Telephone: (303) 236-8384 x 278

FAX: (303) 236-0199

References:

Colorado State University Integrated Decision Support Group, 1997, "Graphical WASP User Manual Version 1.0, Fort Collins, Colorado.

Colorado State University Integrated Decision Support Group, 1997, "Pre-Processor for WASP - Routine Descriptions, Fort Collins, Colorado.

IV. Budget Costs:

Cost Plus Fixed Fee (negotiable) for application and use of the tool. Base funding of $95,000 to begin modifications and development for Phase I. Further development costs for modifications depend on targeted modeling projects and client needs (also negotiable).

Level 1 (technician)	70 staff days @ $448/day =	$31,360
Level 2 (Engineer/Scientist)	90 staff days @ $568/day =	$51,120
Level 3 (Peer Review)	10 staff days @ $680/day =	$6,800
Nonlabor Costs (Travel, other)		$5,720
Total		**$95,000**

II. Title Page

a: Title of Project: Modification and Application of Existing Tools to Process Data for Models Used in the CALFED Program

b: Name of Applicant/principle investigators; address, phone/fax/e-mail; organizational affiliation:

Merlynn D. Bender, M.S.Env. Eng., M.S.C.E., P.E., Environmental/Hydraulic Engineer, U.S. Department of Interior, Bureau of Reclamation, Land Suitability and Water Quality Group, Denver Federal Center, Mailcode D-8570, P.O. Box 25007, Denver, Colorado 80225, Telephone (303) 236-8384 x 278, FAX (303) 236-0199, E-mail mbender@do.usbr.gov

Luis Garcia, Ph.D., Director of Integrated Decision Support Group, Colorado State University, 601 South Howes Street, #410, Fort Collins, Colorado 80523, Telephone (970) 491-5144, FAX (970) 491-2293, E-mail garcia@engr.Colostate.EDU

Russell Kinerson, Ph.D., Chief of Science and Technology, Office of Water, U.S. Environmental Protection Agency, 401 M. Street S.W., Mailcode 8623, Washington, D.C. 20460, Telephone (202) 260-1330, FAX (202) 260-9830, E-mail kinerson.russell@epamail.epa.gov

c: Type of Organization and Tax Status:

Federal Government (exempt tax status), State Controlled Institution of Higher Learning (exempt tax status)

d. Tax Identification Number and/or Contractor license: (Not Applicable)

e. Technical and Financial Contact person(s), address, phone/FAX/E-mail: (Same as above)

f. Participants/Collaborators in Implementation: Interagency Agreement (IAG) between U.S. Department of Interior Bureau of Reclamation Science and Technology Program, U.S. Environmental Protection Agency, Office of Water. Cooperative Agreement between U.S. Department of Interior Bureau of Reclamation and Colorado State University Integrated Decision Support Group.

g. RFP Project Group Type: OTHER SERVICES